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Mask induced dermatoses during COVID-19 pandemic: A questionnaire-based study in 12 hospitals of Korea

Running title: Mask-related dermatoses during COVID-19 pandemic

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Abstract

Background: During coronavirus disease 2019 (COVID-19) pandemic, various adverse skin reactions to long-term mask wearing have been reported.

Objective: We aimed to assess the clinical features of mask-induced dermatoses and recommend prevention and treatment options.

Methods: From April to August 2020, questionnaires including preexisting skin disorders, patients' reported mask-related symptoms, their daily mask wearing duration and frequency, types of masks used, whether they are health care workers, and demographic information were distributed to patients of 12 hospitals. Dermatologists assessed skin lesions, confirmed diagnosis, and recorded treatment modalities.

Results: Itchiness was the most frequent symptom, mostly affecting the cheeks. Most common skin disease was new-onset contact dermatitis (33.94%), followed by new-onset acne (16.97%) and aggravation of preexisting acne (16.97%). Daily wearing (p=0.018) was significantly associated with new-onset contact dermatitis. More than half of the patients with preexisting skin problems experienced aggravation while wearing masks. Longer duration (more than 6 hours/day, p=0.043) and cotton masks (p<0.001) significantly increased acne flare-up. Healthcare workers had a higher incidence of skin disease. Skin lesions were generally mild and well tolerated with topical agents.

Limitations: Effect of seasonal characteristics and other risk factors were not assessed. The patients were visiting dermatologic clinics and had interest in their skin status. Thus, a selection bias may exist.

Conclusion: Mask-induced/triggered dermatoses contribute to increase the dermatological burden during pandemic.

Introduction

A novel coronavirus, SARS-CoV-2, was first identified as the pathogen responsible for an outbreak of viral pneumonia in Wuhan, China in January 2020. Since then and until now, the disease, later named as coronavirus disease 2019 (COVID-19), has spread globally[1]. Stringent measures have been taken to limit COVID-19 spread. [2] To combat this highly contagious disease, wearing personal protective equipment (PPE), such as a mask that shields respiratory infection is recommended, especially for health care workers[3]. Due to the prolonged use of PPE, direct skin damage and aggravation of preexisting dermatoses, such as contact dermatitis, seborrheic dermatitis, and acne have been reported frequently among health care workers[4],[5],[6]. A recent observational study reported that long-term mask wearing appeared to trigger acne and rosacea flares.[7] Mask-induced Koebner phenomenon was also highlighted, especially in psoriatic patients. [8]

In spite of the worldwide debate on whether facial masks should be worn by the general population, it is quite clear that protective actions at an individual level can contribute to the reduction of viral transmission and prevention of community outbreak[9]. In this context, the public health authority of Korea has obligated the general use of masks, particularly in crowded public spaces from the very beginning of the pandemic on February 2020[10]. Since then, with the increase in mask usage time, mask-induced facial dermatosis in the general population came to our attention. However, there is a lack of a large population-based study on adverse skin reactions to long-term mask wearing in non-healthcare workers. Therefore, we aimed to assess the prevalence, clinical features, and prescribed options for these mask-induced dermatoses, in order to further suggest proper preventive measures in these cases.

Methods

Study design

We conducted a multicenter observational study from April to August 2020 in the Republic of Korea. A total of 12 university hospitals or tertiary hospitals participated in this multicenter study. The study population included patients who visited the dermatology department of hospitals. The inclusion criteria were presence of skin symptoms or skin lesions related to wearing facial masks during the COVID-19 pandemic.

Ethics evaluation

The study protocol was in accordance with the guidelines of the Declaration of Helsinki and Korea Good Clinical Practice. The study was approved by the Institutional Review Board of Inje University Seoul Paik Hospital (IRB-No. 2020-05-005-005). All patients voluntarily participated in the study, and written informed consent was obtained from all participants of the prospective study after a full explanation of the risks and benefits of the study.

Questionnaires

Questionnaires were used to obtain information regarding facial mask use among patients (Supplementary 1, 2). The type of mask and the frequency or duration of wearing masks were included in the questions of the questionnaires. Regarding the type of mask, the survey items referred to the N95 mask, KF94/KF80 mask, surgical/dental mask, and cotton mask. KF stands for Korean Filter certified by the Korea Food & Drug Administration; next to it is a number that represents the filtration rate of particles. Demographic information, including sex, age, previous skin disease, and history of general disease were recorded. The dermatologists assessed subjective skin symptoms, objective skin lesions, and affected sites of skin reactions. Based on skin conditions, the dermatologists confirmed the dermatologic diagnosis of the patients. Additionally, treatment methods for the patients were recorded by the dermatologists.

Statistical analysis

Statistical analyses were performed using SPSS for Windows version 19.0 (SPSS Institute, Chicago, IL, USA). Demographic characteristics and incidence rate of each disease were analyzed using the Student's t-test and Pearson's Chi-square test. The significance level was set at 5% (i.e., p-value < 0.05 was considered statistically significant).

Results

Demographics

A total of 330 patients were enrolled in the study. Of these, 65.15% (n = 215/330) were female and 34.85% of (n = 115/330) were male. The mean age of the patients was 35.50 ± 14.45 years. Of the total 330 patients, 109 (33.03%) were in their 20s, 89 (26.97%) were in their 30s, and 40 (12.12%) were in their 40s. Of these, 27.27% (n = 90/330) were healthcare workers (HCWs). Of the total patients, 82.42% (n = 272/330) reported to have preexisting skin dermatosis. Detailed information on facial masks is summarized in Table 1.

Reported skin reactions to facial masks

A total of 92.73% of patients (n = 306/330) complained of subjective skin symptoms. The most commonly reported dermal symptom was itching (66.06%), followed by stinging (31.52%) and dryness (26.36%). Objective skin lesions were found in 93.64% of patients (n = 309/330), mainly with erythema (60.91%). The details of skin reactions related to facial masks are shown in Table 2. The cheek was the most commonly affected site (70.61%). Other involved sites were the chin (46.67%), lip, and perioral area (40.48%), nose (21.52%), and ear (10.27%) (Figure 1).

Diagnosis of mask-related skin disease

In case of various skin diseases accompanied together in a patient, the dermatologist classified skin diseases of the patient into major and minor diagnosis. Aggravating skin disease was independently defined by distinguishing it from a case of newly occurring skin disease. In addition, we analyzed the correlation between the incidence of skin disease and variables. The variables included occupation (whether they were or were not HCWs), types, and wearing periods of masks.

The most common skin disease of major diagnosis was new-onset contact dermatitis (n = 112/330, 33.94%), followed by new-onset acne (n = 56/330, 16.97%) and aggravation of preexisting acne (n = 56/330, 16.97%) (Table 3). Among patients with preexisting skin dermatosis, 57.35% (n = 156/272) experienced worsening of preexisting skin dermatosis (including acne, atopic dermatitis, contact dermatitis, seborrheic dermatosis, and rosacea). Acne was the most frequently aggravated disease while wearing the mask in this pandemic (n = 56/120, 46.67%).

HCWs, N95/KF94/KF80 masks, and daily wearing of masks were associated with increased occurrence of contact dermatitis, respectively, compared to individuals who were not HCWs and not wearing surgical or cotton masks everyday (Table 4). HCWs were related to more reports of aggravation of acne (28.89%, $p = 0.004$) compared to the general public group (12.5%). Patients who wore cotton masks experienced a significantly increased incidence of acne flare-up (50.0%, $p < 0.001$) when compared to the N95/KF94/KF80 group (11.98%). Patients who wore masks for more than 6 hours a day (23.93%, $p = 0.043$) were more likely to report worsening of acne than those who did for less than 6 hours a day (10.18%).

A total of 259 out of 330 patients (78.48%) needed further treatment mainly with antihistamines (42.42%), topical steroids (29.7%), and topical tacrolimus/pimecrolimus (17.58%).

Discussion

This descriptive study investigated the demographics of patients who visited dermatologists with mask-related problems and analyzed the possible relevance of disease and mask wearing patterns. Itching sensation was the most frequent symptom. Among several facial areas, the cheeks were the most commonly affected sites of dermatosis. Newly developed contact dermatitis was the most common diagnosis made with mask-related dermatoses. More than half of the patients with preexisting skin problems experienced aggravation while wearing masks. Especially, acne was the most frequently aggravated disease. As expected, HCWs were related to a higher incidence of skin diseases, such as contact dermatitis or acne flare-up.

Our results of general public data differ from those of previous studies investigating skin damage among HCWs in the following points [5], [11], [4]. First, fewer cases of pressure injury due to masks were reported in the general population than in HCWs. Second, the most affected area was the cheek, not the nasal bridge, as in HCWs. Third, symptoms of dryness/tightness and desquamation were less reported in the general population. These distinctions may be due to the fact that non-HCWs rarely wear multi-layer PPE, such as full-face respirators, goggles, and face shields, similar to HCWs. This can not only prevent simultaneous compression by masks and goggles, but also reduce the increasing rate of temperature and humidity inside the preventive shields [5]. Moreover, KF94 and KF80 masks were distributed by the Korean government among the general and were recommended to wear surgical or cotton masks in order to ease breathing, which are less fitting than N95 masks that HCWs usually wear. Unlike non-HCWs, HCWs continuously wear more fitting masks without taking them off for a longer duration.

Contact dermatitis was related to HCWs, wearing relatively tight masks, and daily use of masks. HCWs are more likely to be exposed to the culprit allergens during their previous work. The allergens associated with facemask contact allergy were nickel and N-Isopropyl-N'-phenyl-1,4-phenylenediamine (often abbreviated IPPD), reported by an occupational skin surveillance scheme between 1993 and 2013[12]. A recent case report presented formaldehyde and bronopol in a polypropylene surgical mask as a cause of allergic contact dermatitis during the COVID-19 pandemic [13]. In patients with eczematous lesions on their noses and cheeks, which are in contact with facial masks, allergic contact dermatitis should be suspected, and a confirmative patch test can help in establishing the diagnosis. In addition, wearing tight masks even on a daily basis can facilitate allergic sensitization independently, and repeated exposure may cause cumulative disruption of the skin barrier[14], ultimately resulting in visible skin changes in irritant contact

dermatitis[15]. In turn, a damaged skin barrier increases exposure to allergens, leading to sensitization and allergic contact dermatitis in susceptible individuals[16].

Preexisting acne vulgaris worsened under prolonged wearing of masks for more than 6 hours per day. This mask-related acne is often called maskne, which is a well-recognized dermatological comorbidity due to PPE. [7] Mechanical rupture of comedones by pressure and friction may provoke inflammation [4]. The high temperature inside the mask because of resistance to airflow and buildup of facial heat raises the risk of acne flare, as sebum excretion increases by 10% for each 1 °C rise[17, 18]. In particular, squalene is known to extend its portion in surface lipids when temperature increases[19]. Furthermore, the elevated ambient humidity can also aggravate acne via the portal occlusion of hydration and damage to the upper portion of the pilosebaceous duct. Sweating and increased humidity may contribute to the swelling of keratinocytes, thereby obstructing the follicles[20]. Moreover, changes in skin surface sebum composition, elevated CO_2 levels under the mask, and humid environment are conducive to bacterial proliferation that can induce acne. As our results demonstrate, multiple reuse of cotton masks without adequate sterilization can promote bacterial growth.

Our research is important in that it includes large-scale data that reflect the obligated long-term mask wearing both in the general population and the healthcare workers. Through the results of the unique preventive measures in Korea, we can forecast the potential dermatologic problems as prolonged and generalized mask wearing becomes more common worldwide during the COVID-19 pandemic. This data can be utilized for public education to avoid mask-related adverse skin reactions preemptively.

By expecting the occurrence, the clinicians can mitigate the potential risks proactively with those who have a past medical history of dermatologic disease. The high-risk population with previous irritation or contact dermatitis can be educated to apply prophylactic dressing or add a scrap of cotton or gauze inside the mask to avoid direct contact[15, 21, 22]. Also, patients with dermatological conditions well-known for their Koebner phenomenon, such as psoriasis or vitiligo should be educated for avoiding pressure and friction. [8] Since patients with a disrupted skin barrier due to atopic dermatitis or rosacea can easily experience dryness and scales, they are recommended to apply highly potent moisturizers both before and after wearing masks to prevent such discomfort [4]. For acne prone skin, a disposable mask is preferred to a reusable cotton mask. Scarano *et al*. reported that taking the masks off rapidly decreased skin temperature after 1 min, returning to the baseline after 5 min [17], proper break during mask wearing would alleviate the

acne flare. Non-comedogenic and oil-controlling moisturizers should be applied before and after wearing masks.

There are some limitations to our study. First, we administered the questionnaire from April to August 2020 and seasonal characteristics, such as temperature and humidity during this period could affect the skin condition. Second, the study group included patients who visited dermatologic clinics and had interest in their skin status. Fragile population like oncological patients was limited for their access to dermatologists during pandemic crisis. [2] Therefore, the result may contain a selection bias. Third, possible risk factors in participants' daily lives other than mask wearing habits were not investigated.

Nevertheless, in light of the results reported in our study, it is helpful for dermatologists to notice and expect mask-related skin problems, such as irritation, contact dermatitis, or acne flare-up. Although most cases are clinically mild, the increased likelihood of hand-to-face and hand-to-surface contact because of such lesions is no more a mild issue considering the viral transmission[23]. Since the role of face touching and surface contact in the viral spread has been highlighted, clinicians should put an active effort to alleviate the source of itch or irritation[24]. Based on our data, both clinicians and patients can be reassured that these conditions are easily managed mostly with topical agents. Along with actively relieving the symptoms, dermatologists can encourage patients to wear masks in their usual lives without fearing skin problems.

In conclusion, long-time mask wearing during the COVID-19 pandemic in the general population may lead to both aggravation of preexisting dermatoses and novel development of distressing skin problems. It is important for dermatologists to be aware of and actively manage these conditions in order to encourage proper and rational mask wearing, which is a paramount preventive means in our fight against COVID-19.

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Table 1. The type of mask and the frequency or duration of wearing mask

		Patients numbers (N = 330)
Type	N95/KF94/KF80	192 (58.18%)
	Surgical mask	122 (36.97%)
	Cotton mask	16 (4.85%)
Frequency (days/week)	< 7 days/wk	117 (35.45%)
	7 days/wk (everyday)	213 (64.55%)
Duration (hours/day)	< 6h/d	167 (50.61%)
	≥ 6h/d	163 (49.39%)

Table 2. Skin reactions related to facial masks

		Patients numbers (N = 330)
Skin symptoms*	Itching	218 (66.06%)
	Stinging	104 (31.52%)
	Dryness	87 (26.36%)
	Tightness/pressure	74 (22.42%)
	Burning	45 (13.64%)
Skin lesions*	Erythema	201 (60.91%)
	Papule	112 (33.94%)
	Pustule	96 (29.09%)
	Scale	83 (25.15%)
	Erosion	28 (8.49%)

*With overlaps

Table 3. Mask-related skin disease diagnosed by dermatologists

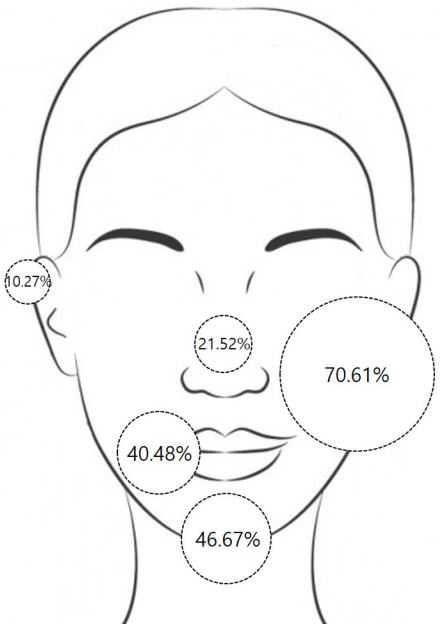
	Patients numbers (N = 330)
Contact dermatitis	112 (33.94%)
Acne	56 (16.97%)

Aggravation of acne	56	(16.97%)
Aggravation of atopic dermatitis	26	(7.88%)
Aggravation of rosacea	24	(7.27%)
Aggravation of contact dermatitis	14	(4.24%)
Rosacea	8	(2.42%)

Table 4. Analysis of variables associated with contact dermatitis

Variables		Total	Contact dermatitis			
		N	n	%	p-value	
Total study population		330	112	33.94		
Occupation	not HCWs	240	73	30.42	0.375	
	HCWs	90	49	54.44	< 0.001*	< 0.001* (vs. general public)
Type of mask	N95/KF94/KF80	192	82	42.71	0.051	
	Surgical	122	28	22.95	0.025*	< 0.001* (vs. N95/KF94/KF80)
	Cotton	16	2	12.50	< 0.001*	< 0.001* (vs. N95/KF94/KF80)
Period	< 7 days/week	117	30	25.64	0.098	0.018* (vs. everyday)
	Everyday	213	82	38.50	0.279	
	< 6 hours/day	167	62	37.13	0.482	0.318 (vs. ≥ 6 hours/day)
	≥ 6 hours/day	163	52	31.90	0.651	

*Pearson chi-square test, p-value < 0.05; statistically significant



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